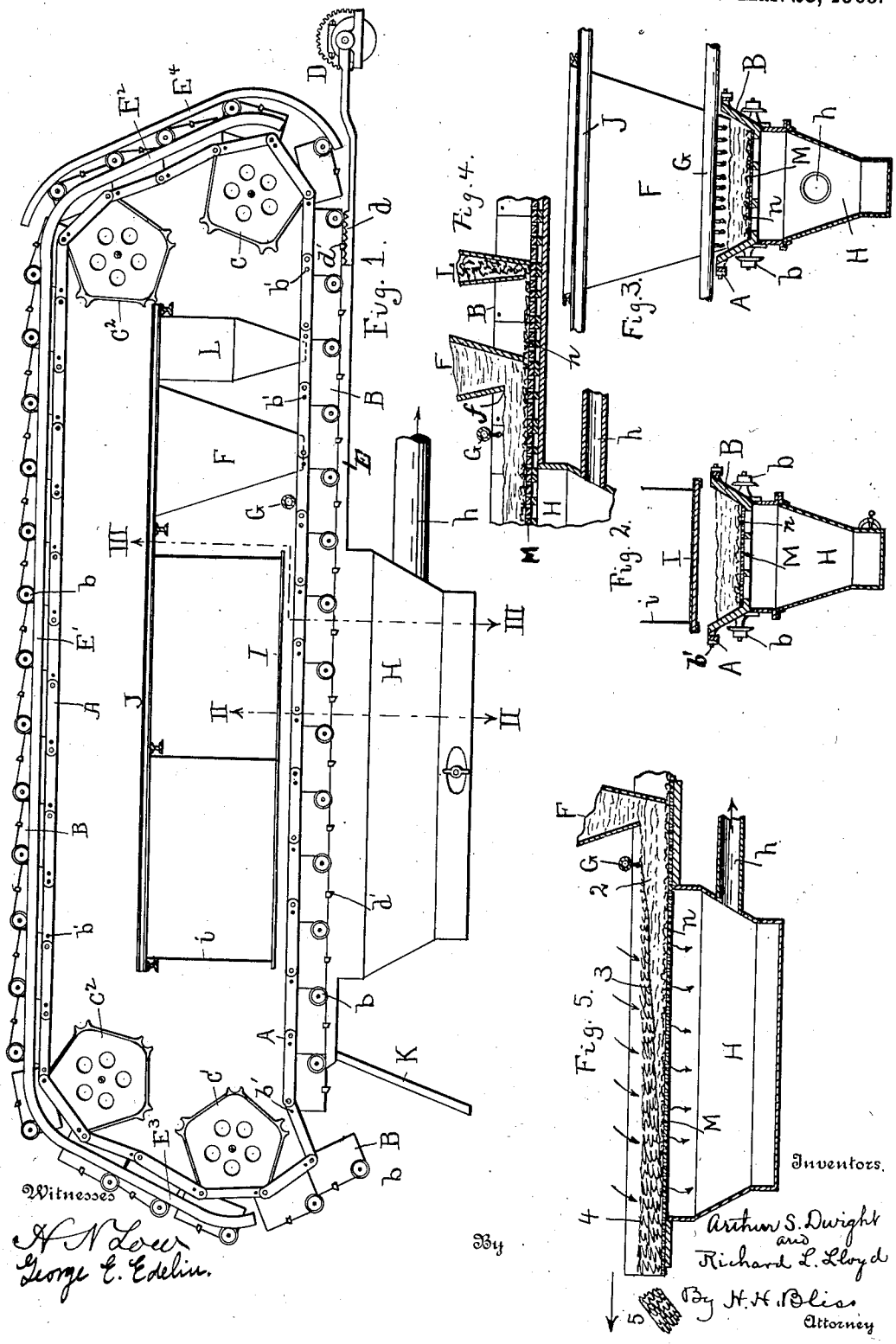
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APPARATUS FOR ROASTING AND SINTERING ORES.

APPLICATION FILED JUNE 3, 1907.

916,393.

Patented Mar. 23, 1909.



UNITED STATES PATENT OFFICE.

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APPARATUS FOR ROASTING AND SINTERING ORES.

No. 916,393. Specification of Letters Patent. Patented March 23, 1909.

Application filed June 3, 1907. Serial No. 377,058.

To all whom it may concern:

Be it known that we, ARTHUR S. DWIGHT and RICHARD L. LLOYD, citizens of the United States, formerly residing at Cananea, Sonora, Republic of Mexico, the said ARTHUR S. DWIGHT now residing at Joliet, in the county of Will, State of Illinois, and the said RICHARD L. LLOYD now residing in the city, county, and State of New York, have invented certain new and useful Improvements in Apparatus for Roasting and Sintering Ores, of which the following is a specification, reference being had therein to the accompanying drawing.

This invention relates to improvements in the art of treating ores, particularly those which require roasting and sintering, such as sulfur-carrying copper ores, and are of such nature that once being ignited an internal combustion of some of the contents of the ore mass can be maintained, provided a suitable oxidizing atmosphere be supplied.

The invention has for its object to produce apparatus that may be worked automatically and economically in the treatment of ores for the purpose of reducing them to sintered masses of convenient form and nature for subsequent treatment where necessary, as for example in a blast furnace.

Figure 1 is a side elevation of an apparatus comprising an endless or continuous support or carrier for the ore, the carrier being made up of a series of connected or articulated elements. Fig. 2 is a cross sectional view taken on the line II—II, Fig. 1. Fig. 3 is a cross sectional view taken on the line III—III, Fig. 1. Fig. 4 is a central longitudinal section of a part of the apparatus taken through the feed hopper and the contiguous parts. Fig. 5 is a longitudinal sectional view, largely diagrammatic in character, illustrating the process carried on by the apparatus herein shown.

The means for supporting the ore during the time when it is subjected to treatment, is shown as composed of an endless system, which, in this case, comprises ore receiving and carrying means and devices, such as chains or cables for propelling the ore carriers. There can be modification in many respects as concerns these devices, and it will be understood that those which are shown and are herein described are merely selected for the purpose of illustration.

In the mechanism in the last said figures, A, A indicate two endless chains which are mounted upon and fitted to sprocket wheels C, C′, C^2, C^3. B, B indicate ore carrying receptacles, suitably connected to the chains A. Each of these receptacles, buckets, pans or pallets is connected to the chains in suitable manner, as for instance, by pintles at b', the connection being preferably such that the buckets or pallets shall be allowed to drop at certain points in their circuit for the purpose of discharging their contents b, b indicate anti-friction rollers, each bucket or pallet being provided with two of these. The buckets or pallets can be formed of any suitable material, we, at present, preferring to cast them in the manner shown in elevation in Fig. 1 and in section in Figs. 2, 3 and 4. When made as illustrated they have side walls and a grated bottom which can be cast integral with the walls. It will be understood that, in this carrying system, there is provided a substantially continuous ore support. When the parts are constructed and related in the way shown in these figures, the buckets or pallets are situated in horizontal planes below the horizontal planes of the chains, when they are traveling through that part of the circuit where they are in action. To support these buckets or pallets properly we prefer that they should rest upon and move along ways or rails E in the lower part of the system, and we arrange rails E′ in the upper part thereof in position to have the wheels b, b travel along the same. For the upgoing leg of the system track rails are provided such as shown as E^3, these leading to and being substantially continuous with the upper rails E′. And at the down leg there are rails E^2 on the under sides of the rollers, and retaining rails or bars E^4 which lie on the outside of the rollers as they move downward, the rails E^2 connecting with those at E′ above. In this mechanism, a continuously progressive movement or advance of the carrier system is effected by the driving devices indicated as an entirety by D, and having ratchet pawls d or equivalents, the teeth or serrations of which are adapted to engage with lugs d' projecting laterally from the buckets or pallets or other suitable part of the carrier. The speed of advance can be regulated as occasion requires.

The material to be treated is delivered to

the ore receiving and carrying devices in any suitable way. We prefer to employ a hopper or bin-like device, such as indicated at F, from which the ore can pass either in a continuous regulated stream, or from which it can be delivered by any well known feeding apparatus. It is desirable to so deliver the ore to the carrier that a stream or mass thereof shall be formed which is substantially uniform in depth and width, and this end can be reached either by properly regulating the downward movement of material from the hopper, or by supplying distributing devices. In practice, we have found that under all ordinary circumstances it is sufficient to have the bottom opening of the hopper of proper size and extending downward to the front wall at the bottom so as to serve as a leveling or scraping flange or lip *f* which insures the proper depth of the ore.

It will be understood that this mechanism and process are mainly designed for the treatment of "fines" or reduced ore, and when such material is being passed into the carrier the particles being substantially uniform in size, the bottom can be so regulated as to permit the passage of a constant stream which can be regulated. Immediately after the material has been delivered properly to the carrier, it is ignited at the top surface. This igniting can be accomplished in any suitable way. As illustrated in the drawings, I provide an ignition pipe at G, which may be connected to a gas supply of any available sort; and adapted at will to throw a flame or jets of flame upon the top surface of the ore as it passes below.

The bottoms of the buckets, pans, or pallets B, as above described, are formed with openings. If grate like bars are cast in the way above described, they may, in some cases, be used to directly support the ore, but we prefer to utilize them rather as supports for a sheet of perforated reticulated metal M. As will be explained more fully below the bottom parts of the carriers are liable to rapid impairing and destruction from corroding and other causes. By supplying separately formed detachable bottom elements they can be readily removed after they have become impaired, without requiring the removal of the entire bucket or pallet. The apertures or openings through the bottoms of the buckets are for the purpose of permitting the downward passage of currents of air.

H indicates an air or suction box or trunk situated below the ore carrier. The walls at its upper edges are so arranged as to fit tightly as possible to the bottom edges of the buckets or pallets as they move over so as to maintain an air tight joint. Their lower parts are so shaped as to assist in collecting the air which is drawn from the box or trunk H through the duct at *h* by any suitable exhaust apparatus, such as a suction fan or chimney stack. The air that is thus drawn into the box or trunk H comes from the region above the mass of ore which is slowly traveling over the trunk. This air enters the mass of ore and passes down through the interstices supplying the oxygen necessary for the combustion of the combustible elements. It is desirable in most cases to retain as much as possible of the heat which is generated by the combustion referred to, and to prevent its loss by radiation upward we employ a hood or shield I of suitable material such as a sheet of steel or iron which is arranged a short distance above the tops of the buckets or pallets and can to advantage be in plan area approximately commensurate with the plan area of the air box or trunk H. This shield or hood may be supported in any suitable way. I have shown it as being carried by hanger rods *i* which at their upper ends are secured to frame bars or beams at J. The air which is drawn in to and through the mass of ore can enter with sufficient freedom into the space below the shield or hood.

After the ore has been subjected to the treatment, which will be more fully referred to, it reaches the discharging point. At a suitable distance beyond the trunk or air box H the supporting tracks E terminate and when the sections of the endless carrier reach the ends of the track rails they drop, turning upon their hinges or pintles *b'* which, as will be seen, are at the front end of each of the buckets or pallets. Preferably the parts are so arranged and related that the dropping will be accompanied by more or less of a shock or jar which insures the complete emptying of the contents. If desired a chute or apron-like plate can be employed as shown at K against which the dropping ore can fall as it leaves the pallet and by which it can be guided to any desired place of deposit.

Under some circumstances, and for purposes which will be more fully referred to, it is desirable to provide the grate like bottom of each bucket or pallet with a layer *n* of inert or refractory material for the purpose of assisting in preserving the bottom part of the carrier from destruction. At present I will mention lime rock as a substance which can be used for this purpose. When employed it is placed in a suitably thick layer upon the bottom of the pallets or buckets at times before they are charged with the ore. In the apparatus which we have been describing provision is made for supplying a material of this character automatically, although it will be understood that the end aimed at by the characteristic features of our process can be reached if this material were applied manually. L indi-

cates hopper or bin also arranged and supported directly above the lower part of the carrier. It is supplied with a requisite amount of the material that is to be deposited on the bottom of the carrier, and the layer that is there placed is ready to receive the superincumbent mass of ore which is subsequently introduced from the hopper F in the way above described.

Having thus set forth the principal matters incident to the construction and arrangement of the parts we have illustrated, the following is to be noted with respect to the mode of operation. If it be assumed that the hopper or bin at F is charged with the ore that is to be treated, and that the hopper at L is charged with the refractory material to be employed, and that the movable and operative parts of the mechanism are set in proper motion the following will be the result. As each pallet or bucket passes beneath the hopper L it is provided with a shallow layer of the refractory material which while covering the grated or reticulated bottom element of the bucket is sufficiently porous or open to permit the downward passage of gases and products of combustion. Then as the buckets or pallets successively reach the vertical lines of the hopper or bin F they are next supplied with the predetermined charge of ore which lies upon the layer of refractory material and of a depth made as uniform as possible through the series. Then as the pallets or buckets successively reach the transverse lines of igniting the upper part of the mass of ore is ignited by such means as are adopted. At an early moment after the ignition the newly ignited area at the top of the advancing stream comes into the vertical planes of the area of downward air suction, whereupon the ignition is insured and continued so long as the material is above the air box or trunk H or until the oxidizable components have been exhausted. Let it be assumed that the material which is to be treated is a copper sulfur ore of average natural character. The firing having been commenced in the way described it will continue, the fire extending gradually deeper and deeper into the mass until it has reached the bottom. The various factors including the speed of travel of the carrier, the depth of the mass thereon, and the proportion of oxidizable ingredients are so adjusted and related that the process of combustion shall continue until just about the time when the material reaches the remote end of the air box or trunk H.

We above referred to the use of lime rock as a suitable material for the initial layer at the bottom of the ore mass; and in this connection the following is to be noted.

The bottom element of the ore carrier, whether it be an integral grate or a separately formed apertured bottom element, should be constructed of a material capable of economically resisting the destructive agencies to the action of which it is subjected when in operation, these being hot sulfurous and other corrosive gases, water vapor, hot metallic sulfur and other metalloids or metals which may liquidate down from the mass of superincumbent material that is undergoing treatment. They are also liable to impairment from sudden changes in temperature. The severity of these conditions varies with different kinds of material, being the greatest when the proportion of sulfur is high. With a low content of sulfur the temperature generated during the operation and the temperature of the resulting gases does not rise very high, and a grate of cast iron or of perforated wrought iron plate will suffice. Where higher temperatures are generated perforated copper plates have been used to advantage and also perforated asbestos board. Use may be made also of grates formed of bars or plates of refractory earth material, bricks, fire clay, porcelain or the like. Water cooled pipes or grate bars may be used. But whatever materials or devices are used to serve as bottom elements for the carrier it is of advantage to protect them as far as possible from the action of the heated gases and fluid. And hence it is that we make provision, as above described, for supplying a layer of inert or refractory character to lie between the bottom support, proper, and the superincumbent mass of ore.

We have above referred to lime rock suitably reduced in size of particles as one body that can be used for this purpose; but here also there can be variation as desired. Good practice requires that the material chosen for this purpose of protecting the carrier bottom should be of such composition that it can be present together with the treated ore during the later steps of treatment, for example during the smelting operation, without impeding such operation or impairing its results, commercial or metallurgical. Instead of the limestone mentioned use can be made of oxid iron ore, silicious or earthy ores, poor in sulfids, which ores may be not only not hurtful but desirable ingredients in the blast furnace mixture. Or in lieu of these or any of them use may be made of a layer of sintered ore suitably reduced. However, we do not present claims for the process of feeding a layer or stratum of one kind or class of material and a second layer or stratum of another kind or class of material in the preparation of a blast furnace charge produced by roasting the combustible ore ingredients while the said layers are in contact or superimposed; nor do we herein present claims for the means or apparatus for arranging the materials to be roasted or sintered into a blast furnace charge in layers

as just described, as these constitute the subjects-matter of claims appearing respectively in the applications of Arthur S. Dwight, Serial No. 376,138, filed May 28, 1907, and Serial No. 347,872, filed December 14, 1906.

What we claim is:

1. In an apparatus for roasting and sintering ore by internal combustion, the combination of an endless ore support, means for moving the support, and means for causing the products of combustion and a current of air to pass through the ore mass in a direction transverse to the movement of the support, substantially as set forth.

2. In an apparatus for roasting and sintering ore by combustion maintained in the ore mass, the combination of a continuous or endless ore support, means for moving the support, and means for causing the products of combustion to pass through the mass and for causing a current of air which supports internal combustion in the ore mass to pass through a limited portion of the mass while upon the support, substantially as set forth.

3. In an apparatus for roasting and sintering ore, the combination of an endless ore support, means for moving the support, means for causing a current of air to pass through the ore mass in a direction transverse to the movement of the support and for carrying the products of internal combustion through the mass, and means for limiting the region of the said air passage, substantially as set forth.

4. In an apparatus for roasting and sintering ore, the combination of an endless ore support having a grate surface upon which the ore may be placed, means for moving the support, and means for causing a downward moving current of air to pass through the material on the grate through a limited region in the circuit of movement of the ore support, substantially as set forth.

5. In an apparatus for roasting and sintering ore, the combination of an endless ore support, means for moving the support, a feeder for supplying ore thereto, means for causing a current of air to pass transversely through the ore while on the said support to maintain internal combustion within the ore mass, and causing the products of combustion to move through the mass and means for removing the blocks or cakes of sintered ore from the support after the region of combustion has been passed, substantially as set forth.

6. In an apparatus for roasting and sintering ore, the combination of an endless ore support, a substantially air-tight chamber across which the said support moves, means for causing air to pass through the ore mass into the said chamber, means for moving the support, and means for feeding the ore material thereto, substantially as set forth.

7. In an apparatus for roasting and sintering ore, the combination of a continuous movable ore support, means for feeding the ore thereto, a substantially air-tight chamber across which the support moves, means for causing air to pass through the ore mass on the support and into the said chamber, and means situated between the ore feeder and the said chamber for igniting the ore, substantially as set forth.

8. In an apparatus for roasting and sintering ore by internal combustion, the combination of an endless ore support having a grate surface, means for feeding the ore to the said support, an air trunk or box across which the support is moved, means for causing the air which moves through said trunk or box to support internal combustion within the ore and to carry the products of combustion through the ore and means for removing the material from the support after it has been treated, substantially as set forth.

9. In an apparatus for roasting and sintering ore, the combination of an endless ore support, separable grate sections carried thereby, means for feeding the ore to the support, means for removing the ore after it has been treated, and means situated between the said feeding and removing devices for causing air to pass through the ore mass in a direction transverse to the movement of the support, and to support internal combustion in the mass and carry the products of combustion therethrough, substantially as set forth.

10. In an apparatus for roasting and sintering ore, the combination of an endless ore support having a grate surface upon which the ore is supported, an air box across an open end of which said grate surface moves, means for feeding material to the ore support before it reaches the said air box, and an igniter for the ore situated adjacent to the edge of the air box nearest the feeder, and close to the upper surface of the ore carried by the support, substantially as set forth.

11. In an apparatus for roasting ore, the combination of an endless support or carrier, a series of independent ore-holding receptacles moved thereby, each receptacle having a grate or pervious bottom, means for moving the support or carrier, means for supplying ore to the receptacles, means for causing air to pass through the grate of each ore receptacle and the body of ore supported thereby during the time the receptacle is moving through part of the path traveled thereby, and means for causing a discharge of the ore after treatment, substantially as set forth.

12. In an ore roasting apparatus, the combination of a support or carrier adapted to move through an endless circuit or path, a series of independent ore receptacles moved

by the said support or carrier and connected therewith by hinges or pivots, each receptacle having a pervious bottom or grate and each being arranged to turn on its pivot or hinge to permit the holder to discharge, means for supplying ore to the said receptacles, means for causing air currents to pass through the grates of the ore receptacles and the body of ore carried thereby to maintain internal combustion within the ore masses, and means for moving the support or carrier whereby the ore receptacles are moved from the place of ore feeding through the region where internal combustion takes place in the ore mass to the place of discharge and back to the place of feeding, substantially as set forth.

13. An ore roasting and sintering apparatus comprising in combination means for supporting a mass of ore over a grated or pervious ore holder, a carrier for the ore holder, a track or way for guiding and supporting the carrier in an endless path, said path passing a point of ore feeding, passing thence through a region of combustion and sintering, and thence to a point of discharge of the sintered ore, means for moving the said carrier, and means for causing currents of air to pass through the pervious ore holder and the mass of ore carried thereby as it passes through the said region of combustion and sintering, substantially as set forth.

14. In an ore roasting and sintering apparatus, the combination of a carrier, a series of independent ore receptacles pivotally connected with the carrier and moved thereby, each receptacle being arranged to turn on its pivot at a place of discharge in the path of the carrier to discharge the sintered ore, an endless track for supporting the carrier in its path, means for moving the carrier, means for feeding ore to the ore receptacles, and means for causing air to pass through the masses of ore supported by the receptacles to maintain internal combustion therein for sintering the ore while the ore receptacles and the masses of ore they contain are in motion, substantially as set forth.

15. In a sintering device, an endless traveling grate comprising individual sections, means for supporting said sections in a horizontal position, means for delivering material upon said grate, means for sintering said material, and means for positively loosening and ejecting the sintered material through a relative movement of the individual sections of the grate.

16. In a sintering device, an endless traveling grate, means for charging said grate, means for sintering the charge, and means for changing the curvature of the grate bottom, thereby causing the positive loosening and ejectment of the sintered material.

17. In a sintering device, a traveling grate, means for charging said grate, means for sintering the charge, and means for loosening and ejecting the sintered material through the relative movement of parts of said grate.

18. In a sintering device, a grate, means for charging said grate, means for sintering the charge, and means for loosening the sintered material from the grate bars and for ejecting the same through the relative movement of parts of said grate.

19. In an apparatus for treating ores containing combustible constituents, the combination of a movable ore support, means for feeding ore thereto, and an igniter for the ore extending transversely across the ore mass and in proximity to the exposed surface thereof, whereby the ore is ignited at its surface as it moves past the igniter.

In testimony whereof, we affix our signatures each in the presence of two witnesses.

ARTHUR S. DWIGHT.
RICHARD L. LLOYD.

Witnesses:
WILLIAM A. BOUKEL,
G. E. SEYMOUR,
H. S. TAYLOR,
H. H. BLISS.